Statistics 621 – Advanced Stochastic Processes
Section 600, Spring Term, 2017

This is an advanced course in stochastic processes. Topics may vary from year to year. They will include both discrete and continuous time processes and possibly point processes. Martingale theory and Markov theory will play important roles.
Although not completely rigorous, the course will be more mathematical than a first course (such as Statistics 615). Measure theory is not required, but a few measure theoretic concepts will be introduced as needed. The intention is to provide a layer of theory that will enhance your ability to read the literature and to do research. Homework problems will include both applied and theoretical questions.

Course Information

Time and Place:	MWF 1:50pm–2:40pm, Blocker 457.
Instructor:	Daren Cline. (http://stat.tamu.edu/~dcline)
Office:	Blocker 459D, 845-1443.
E-mail:	dcline@stat.tamu.edu
Office Hours:	MWF 9:00am–10:00am, or by appointment.
eCampus:	Lecture notes and homework assignments will be available in eCampus.
Text:	*The first is required; the second has exercises and solutions.* • G.R. Grimmett and D.R. Stirzaker, *Probability and Random Processes, 3rd ed.*, Oxford Univ. Press. • G.R. Grimmett and D.R. Stirzaker, *One Thousand Exercises in Probability*, Oxford Univ. Press.
References:	(on reserve in Evans Library) • R.F. Bass, *Stochastic Processes*, Cambridge Univ. Press. • R.N. Bhattacharya and E.C. Waymire, *Stochastic Processes with Applications*, Wiley. • E. Çinlar, *Introduction to Stochastic Processes*, Prentice-Hall. • M. Kijima, *Markov Processes for Stochastic Modeling*, Chapman & Hall. • T. Mikosch, *Elementary Stochastic Calculus*, World Scientific. • S.I. Resnick, *A Probability Path*, Birkhäuser. • S.I. Resnick, *Adventures in Stochastic Processes*, Birkhäuser. • D. Williams, *Probability with Martingales*, Cambridge Univ. Press.
Prerequisite:	Statistics 614 *or* Statistics 615 (or their equivalent). Measure theory is not required nor is prior experience with stochastic processes as the presentation will mostly be self-contained. However, this will be a theoretical, Ph.D. level course, so *some exposure to advanced probability such as either 614 or 615 is necessary.*
Homework:	Homework will be assigned (on the course web page) and collected regularly. Homework is worth 30% of the total term score. *Please see the homework policy below.*
Exams:	One midterm exam worth 30% and a final exam worth 40%. *Please see the exam policy below.*
Exam Dates:	Midterm Exam: TBA. Final Exam: TBA.

Course Information (cont.)

Disabilities Help:	The Americans with Disabilities Act ensures that students with disabilities have reasonable accommodation in their learning environment. If you have a disability and need help, please contact me and Disability Services in the Student Services at White Creek complex, 845-1637.
Academic Integrity:	You are expected to maintain the highest integrity in your work for this class, consistent with the university rules on academic integrity. This includes not passing off anyone else's work as your own, even with their permission. Please see the homework and exam policies below for specifics.
Copyright:	Each document provided on my web pages or by me is copyrighted with all rights reserved, whether or not the document explicitly states so. They may only be used for academic purposes and they may not be reproduced or sold without my permission. You may refer to them for other classes or for research, just as you would any book, as long as you give proper credit and neither you nor anyone else reproduces them for sale or other distribution. To use some of the material for instruction purposes, you need to first get written permission from me (Daren Cline, TAMU Department of Statistics, College Station TX 77845-3143).

Course Outline (*Tentative*)

1. Introduction
- 1-1. Distribution of a Stochastic Process
- 1-2. Conditional Expectation
- 1-3. Stopping Times

2. Countable State Markov Processes, Birth-Death Processes
- 2-1. The Markov Property and Strong Markov Property, Recurrence
- 2-2. Probability Transition Functions and Infinitesimal Generator
- 2-3. Constructive Definition
- 2-4. Kolmogorov's Differential Equations
- 2-5. Invariant Measures, Stationarity and Limit Theorems
- 2-6. Reversibility
- 2-7. Resolvents and Potential Theory

3. Martingales and Supermartingales, Random Walks
- 3-1. The Martingale Property
- 3-2. Maximal Inequalities
- 3-3. Convergence of Supermartingales and Uniformly Integrable Martingales
- 3-4. Reversed Martingales
- 3-5. Continuous Time Martingales
- 3-6. Supermartingales and Stopping Times
- 3-7. Random Walks and Wald's Identity
- 3-8. Martingales and Markov Processes, More Potential Theory

4. Brownian Motion and Diffusion Processes
- 4-1. Diffusions
- 4-2. Brownian Motion
- 4-3. Infinitesimal Generator and Kolmogorov's Differential Equations
- 4-4. Dynkin's Formula
- 4-5. First Passage Times, Scale and Speed Functions
- 4-6. Recurrence and Transience
- 4-7. Connections with Brownian Motion, Random Walks and Birth-Death Processes

5. Point Processes, Poisson Processes (time permitting)

Course Policies

Homework Policy:

Your homework solutions must be your own work, not from outside sources, consistent with the university rules on academic integrity. I expect you to follow this policy scrupulously. *Your performance on the exams is much more likely to be better.* (Also, relying on others' solutions will cause me to think I can ask harder questions on the exams!)

You may use:

- Your textbook and notes from class.
- Your notes, homework, etc., from a related class that you took or are taking.
- References listed on the syllabus.
- Discussion with me.
- *Voluntary, mutual and cooperative* discussion with other students currently taking the class. This does not mean copying from each other.

You may not use:

- Solutions manuals (printed or electronic) other than what is provided with the required texts.
- Solutions from previous classes.
- Solutions, notes, homework, etc., from students who took the class previously.
- Solutions, notes, homework, etc., from classes taught elsewhere or at another time.
- Copying from students in this class, including expecting them to reveal their solutions in "discussion". That is, you may work together as indicated above as long as you prepare your own solutions.

Homework is to be submitted by the end of class on its due date unless I specify otherwise. *Late homework is not acceptable.*

Exam Policy:

Your exam solutions must be your own work, using only resources I explicitly allow, consistent with the university rules on academic integrity.

Each exam will be comprehensive and cumulative.

- Please bring your own paper. I ask that separate problems be on separate sheets.
- Bring resources (such as notes) only if I explicitly allow them.

I will not expect you to quote theorems and results explicitly but I do expect you to demonstrate that you can make correct use of them. Specifically, you will need to:

- Show all your work. This does not necessarily mean showing every individual algebraic or calculus step – but it must be clear what those steps would be.
- Identify (by number, name or description) any theorems, examples or homework problems you use.
- Verify conditions and assumptions as needed for those theorems and examples.
- Clearly identify the solution and/or the end of a proof or derivation.

No exam may taken early or made up, except if you provide a university excused absence with appropriate documentation.

Selected problems from my old exams will be available on the course web page. However, their content may not exactly match this semester's exams.

Makeup Policy:

This is based on university policy.

- If you must miss an exam due to illness or other university excused absence, notify me or the Statistics Department (before, if feasible, otherwise within two working days after you return). Contact me as soon as possible to schedule a make-up exam.
- An Incomplete will be given only in the event you have completed most of the course but circumstances beyond your control cause prolonged absence from class and the work cannot be made up.